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TOPICAL PROBLEMS OF THE MODERN THEORY AND METHODOLOGY OF SPORTS TRAINING

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Abstract

The current achievements of biological sciences give the essential basis for the development of principly new approaches to interpretation of the theory's and method's fundamentals for sport training. These achievements initiate the revision of traditional methodical principles sport thaining's concepts. The aim of this paper is to demonstrate some examples of such innovations and the ways of their realization in training practice of elite athletes preparedness. Such new forms of training process organization as a large training cycle, a training day, and a training seance. The untraditional principles of "developing" microcycles building are also offered.

Key Words: Theory of sport, process of adaptation, a large training cycle, microcycle, training day, training seance.

Introduction

As I have pointed out above [54, 55], the elaboration of the modern science-based theory and methodology of sports training (T&M ST) relies primarily on biological knowledge used, of course, with an eye on the methodological objectives and practical problems of the training of athletes. In furtherance of the basic principles of T&M ST set forth above, here I would like to dwell on some forms of organization of the training process in the field of top performance sports.

The form of the organization of the training process means the mode of optimizing the training process's content in time in accordance with objectives to be achieved. In this way, the time and organization (structure) of training loads are the main and mutually dependent parameters of the organization of the training process. On the one hand, the tasks of training an athlete require time for the effective use of the necessary training loads. On the other, if we consider the calendar of competitions and other factors, time acts as a limiting factor with regard to the method of optimizing training load and, to some extent or other, the time factor determines the choice of the given optimization method. The ability to find the most rational form of organization of training load and materialise this form within the given time framework is the supreme gauge of the professionalism of a coach [54, 55].

The organization of the training process reveals the following forms: a yearly cycle, a large training cycle[1], a microcycle, a training day, and a training seance. The general principles of constructing a yearly cycle for high-class athletes have been formulated clearly enough [27,54]. These principles have been specified with respect to various sports by the authors of numerous advanced degree theses and leading coaches have tested and backed these principles with a wealth of

[1] It is necessary to pay attention to the fact that the large training cycle proceed from the regularities of the adaptive process. This notion (idea) has nothing to do with "macrocycle" as well as with the concept of the so-called "periodization" of training and other L. Matveev's reasoning, become obsolete from longtime.

convincing examples [56]. However, other forms have no yet been elaborated sufficiently well and this affects the quality ofraining topclass athletes. Let us therefore consider the modern concepts and prospects of perfection of such organizational-temporal forms of training as a large training cycle (LTC), a microcycle (MC), a training day (TD), and a training seance (TS) as applied to athletes, whose yearly training is oriented largely to the main seasonal competitions (such as world championships or Olympic Games)[2].

The large training cycle

The large training cycle is a structurally integrated and relatively independent component of the training process, which corresponds to the complete phase of the development of long-term adaptation, the phase characterized by the formation of stable morpho-functional transformations in the human body and the body's corresponding transition to a new, higher level of specific functionality [27, 54-56].

The essence of this phase and, consequently, the content, organization and duration of the LTC are connected with the implementation of what is called the current adaptation reserve (CAR) of the organism [27, 54][3]. In the interests of progress of sportsmanship, the strategy of training within the yearly cycle should have as the'principal task the effectuation (depletion) of CAR for transferring the organism to a new functional level. For this purpose, the LTC should be organizationally isolated within the framework of the training process and duly programmed and successively repeated in time but every time at a higher level of the intensity of the functioning of the body. In the process of training an extra-class athlete, the achievement of all sports-methodological objectives should intrinsically fit in with training's main strategic line aimed at the effectuation of CAR and, most importantly, this should rely on the accompanying morpho-functional gains of the organism.

Depending on the motor specificity of a sport, peculiarities of the organization of competitions, and the traditional calendar of competitions, the LTC can be of yearly, half-yearly on near duration. Experiments confirm that, under the volumetric specific loads mastered by athletes today, with the two-cycle organization of yearly training, the effectuation of CAR takes place within 18-24 weeks [27, 54, 57].

The principal approach to the organization of CAR is demonstrated by Chart 1.

The dynamics of an athlete's specific functionality (B) is determined largely by the

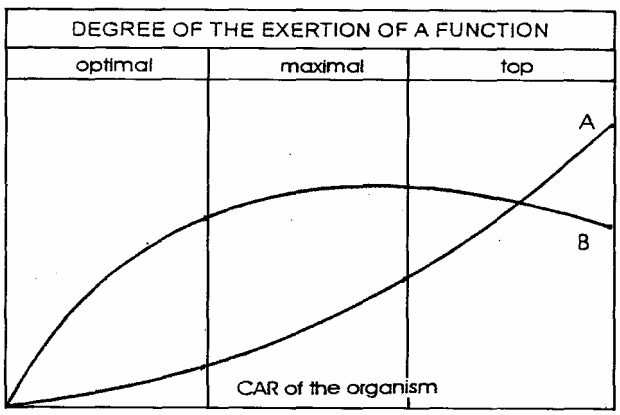

Figure 1. Scheme of the connection of the dynamics of an athlete's state (B) with the strength of the impact of training (A) and the degree of CAR depletion.

[2] As distinguished from training for commercially-oriented competitions.

[3] CAR means the reserve of adaptation energy ensuring the organism the possibility of temporal adaptation to extreme conditions and requiring the greatest possible functional intensity [54, 57].

following two factors: the strength of the impact of training (A) and the capacity of the organism's CAR (abscissa) or, to be more precise, by the degree of CAR depletion. The increment in the body's specific functionality in line with CAR exhaustion requires a rapid rise in the strength of the impact of training. However, in practice, this is expedient and justified only until the level of the athlete's specific functionality (B) reaches the plateau at the expense of the maximum exertion of the function. Further, if we permit the top exertion of the function, the pessimistic form of the training effect of loading will follow — the indicators of specific functionality will begin to decline [41, 681. This can be viewed as the depletion of "accessible" physiological reserves, which does take place with a rationally organised training [27, 54]. It can be surmised that the remainder of the organism's CAR is represented by "automatically protected working reserves" [13] measuring around 30 per cent of the organism's CAR. The effectuation of this CAR component with a high functional effect is possible only in stress-intensified loads or doping. However, this is impermissible with the natural course of training as this can frustrate adaptation and may have more dangerous consequences for the organism.

Two conditions must be ensured by all means in organizing the LTC: the concreteness of the training directivity of loads (what physiological and energy systems, mechanisms and their functional properties will be involved) and the precision of formulating the training task (the exact desired result). That is why in choosing and organizing loads it is necessary to proceed from, first, the knowledge of the functional capabilities of physiological and energy systems, ensuring for the most part and athlete's specific functionality, second, from their adaptation inertness and, third, from the heterosynchronism of the development of adaptation reactions at the level of the organism's various life-sustaining systems during the training process [54, 57, 59, 60].

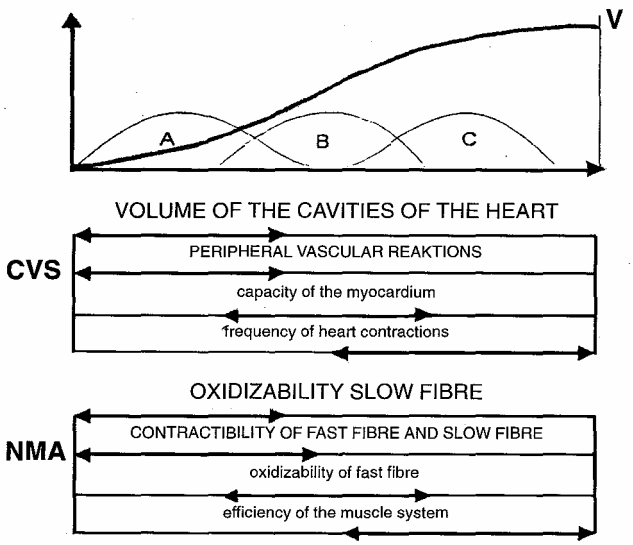

Figure 2. Temporal structure of the target directivity of training impacts on the cardio-vascular system (CVS) and the nervous-muscular apparatus of an athlete, where V - speed of a competitive exercise, and A, B, C - stages of the large training cycle.

Chart 2 illustrates the implementation of these conditions, using cyclic sports as an example. The Chart demonstrates the temporal structure of the target directivity and the conjugation of the complex of training impacts on the functional parameters of the cardio-vascular system (CVS) and the nervous-muscular apparatus (NMA), with the training process's general strategic orientation to the gradual growth of the distance speed (V). The meaning of such a structure is as follows [55, 59, 61]:

a) at the CVS level, training impacts are first (Stage A) simultaneously directed at increasing the volume of the cavities of the heart (dilation) and forming peripheral vascular reactions (blood stream distribution) and subsequently at raising the minute volume of the blood by increasing the capacity of the myocardium (Stage B) and the frequency of heart contractions (Stage C);

b) at the NMA level, simultaneously with the growth of the contractibility of the muscles, there at first improves the oxidizability of the slow (Stage A) and later fast (Stage B) muscular fibres: at Stage C there grows the efficiency of the muscular system in the specific cyclic operating regime;

c) using the vertical, it is easy to see in accordance with Stages A, B and C[4] the conjugation of the training impacts on the CVS (with the help of special distance-controlled facilities) and on the NMA (with the help of special physical training). It should be stressed that special physical training includes special power exercises, particularly those with burdens. However, their objective is to develop not just strength but the local muscular endurance (LME) of the most often-used muscular groups [55, 591.

The reviewed structure of training impacts ensures the coordinated perfection of the organism's muscular, vegetative and energy systems with regard to the speed regime of a distance effort which requires endurance and which effectuates the principles of "the anti-glycolytic" directivity of training and the superposition of the loads of the most frequent directivity [55, 56, 59, 60].

[4] For more details about the tasks, content and succession of the Stages see 55, 56, 59 and 60.

It should be stressed that the model of the LTC (see Chart 1) expresses the principal (strategic) idea of its organization for high-class athletes irrespective of the specific moment of time of the calendar of competitions. In practice, this idea should be used creatively, considering the motor specificity of a sport and the calendar and rules of competitions [27, 55, 601.

In particular, there can be two or three LTCs a year. In this case, the main competitions should fall on the second or third LTC, which fact will determine the objectives and content of each of them [56].

For the effective organization of training impacts on the organism, a LTC should:

- clarify the trends and quantitative-temporal characteristics of the process of the organism's long-term adaptation in a given sport, especially the specificities of the effectuation of its CAR;
- establish training impacts directivity, objectively necessary for the development of the adaptation process, on the organism's physiological and energy systems, and develop corresponding criteria for the differentiation of training loads;
- classify specific training loads by the dominant directivity and categorise them by their training capability;
- elaborate the method of objective control over the dynamics of an athlete's state;
- determine the specific type of adaptation strategy for a given athlete.

Let me stress it that many leading coaches feel it necessary to have these problems solved.

Groping, often intuitively and without a recourse to theory, they are trying to formulate for themselves logical approaches and methodological solutions. They would therefore appreciate any assistance on the part of the scientific community.

The microcycle

Specialists have always devoted much attention to the plotting of microcycles (6, 11, 24, 29, 48, 54, 66, 71). As a matter of fact, the initiation of the Russian T&M SP in the 1950s began from the empirical elaboration of the methods of MC construction. Over the past 25 years projects have been undertaken to experimentally evolve the principles of MC organization, many of these projects mounted by the research personnel of the Kiev Institute of Physical Culture. The practice-oriented direction of this research was determined by the trend, popular in the early 1970s, towards increasing the overall volume of training load, particularly towards increasing the number of training sessions within a MC to 18-20, including 4-6 large-load sessions [11,28,42, 71].

MC studies employ various methods of gaging the dynamics of athletes' state: special motor tests [22, 24, 48, 71], physiological and biochemical methods [1, 2,7, 31, 36, 45,51, 64, 74]. Both groups of methods have brought about valuable and largely coinciding results, although, it must be admitted, the results registered by the second group are more informative and grounded. We, however, should not go into a detailed survey of all these projects here (this should be the subject of a special publication). In this connection it is more important to determine the methodological attitude to the MC issue in general, proceeding mostly from the objective grounds yielded by the second group of projects. To sum up:

1. What underlies the development of athletes' training status is, as is generally known [62-64, 72) the intensified synthesis of structural and enzymic proteins in the active cells, leading via morphological transformations, to the growth of the functional capacity of the cellular structures and, consequently, of tissues, organs and the body as a whole. On the strength of the intensified and purposeful synthesis of proteins, the organism passes from urgent adaptive reactions to long-term adaptation [16, 25, 26, 62, 63]. Within the framework of a MC, the development of the adaptation process can occur provided there is an optimal correlation between the strength of a training impact and the duration of the interval between two adjacent training impacts [9, 64, 68,72]. This means that the art of organizing sports training is reduced to determining a loads regime which ensures the optimal duration of the interval between these impacts: no more and no less than before the termination of the intensified synthesis of proteins conditioned by the previous load [54, 62, 73].

2. The course of the adaptation process and the corresponding dynamics of an athlete's specific functionality within a MC are determined and limited by three basic factors; the reserves and replenishment velocity of glycogen in the muscles and the liver, the duration of the synthesis of proteins, and the functional potential of the hormonal systems. Searches for the rational forms of constructing a MC can be successful only if we consider all these factors [54, 55, 59, 60, 64].

3. Acting as the inductors of the synthesis of proteins are primarily metabolites and cell

decomposition products which form in the course of muscular work. Metabolites specifically determine the set of proteins synthesised in the post-work period. This ensures the correspondence between the enhanced functional activity and the adaptive synthesis of protein-synthesis covers the proteins which are subject to intensified destruction and which are used to form active cellular structures. Synthesis also applies to enzymes which catalyze biochemical reactions underlying the corresponding cellular functions [63,73].

It follows therefrom that in "the developing" MCs aimed at the preferential perfection of a certain functional property (motor ability), training impacts on the organism should provide for the induction of the adaptive synthesis of protein in the corresponding direction with the help of repeated unidirectional loads. The complex organization of an MC in this case, the more so such an organization with large loads (4-6 times a week) would be inexpedient as it would involve tremendous, and unjustified, expenditures of energy not securing the specific criterion of the synthesis of proteins.

4. The principles of MC construction should first of all consider the fact that the purposeful and regulated synthesis of proteins, that is, the plastic ensurance of a function, is a compulsory component of the materialisation of both specific and non-specific adaptive reactions [9, 16, 25, 62- 64]. The entire volume of metabolic processes in the organism at the level of these reactions is regulated by endocrine system [15, 16, 62]. Therefore, repeated large loads in the MC can ensure a training effect only within their current functional capability. Attempts to use large loads of different directivity 4-5 times a week with a 24-hours interval in order, for instance, to improve an athlete's speed development ability and endurance during aerobic and anaerobic work [48, 71] are hardly justified. It is unlikely that as a result of exploiting and suppressing functions determining the ability to reveal some "properties" it would be possible to achieve a high level of efficiency in developing other properties while "the suppressed" functions are restoring their potential [24, 28, 48]. Most probably, repeated volumetric loads would, irrespective of their direction, lead to the exhaustion of the functional potential of the hormonal (mostly sympatho-adrenal and hypophysal-adrenocortical) systems and the stable suppression of their functions, that is, protective reaction necessary to prevent the excessive exhaustion of the organism ("exhausting" MC, 64). This phenomenon was often registered in studies conducted with the help of biochemical methods [1, 36, 45, 51, 74].

My associates organized, with the participation of the biochemistry laboratory of

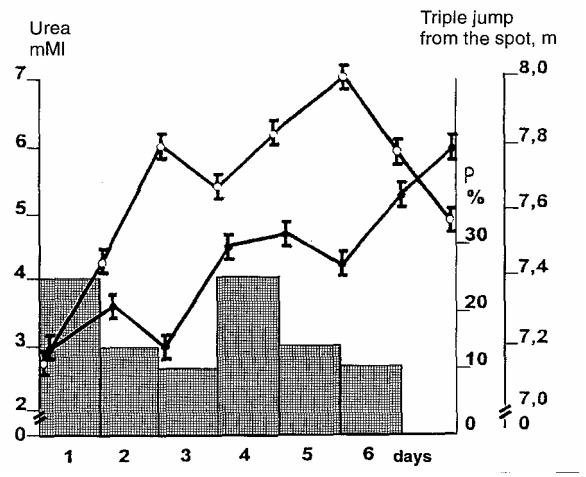

Figure 3. Dynamics of athletes' state in the microcycle (skating, n9). I- urea in the blood, 2 - triple jump from spot. Shaded columns show training loads (R).

the Central Sports Research Institute, a research project to explore the rational forms of MC construction for cyclic sports (Chart 3 — skating, postgraduate V. Grechman) and speed-power sports (Chart 4 — weight-lifting, post-graduate S. Berezhnoi). Let us consider some results of this research.

1. The opposite directivity of the dynamics of urea concentration in the blood and of the ability to perform explosive efforts. The intensified disintegration of proteins, as a result of intensive muscular work, undercuts an athlete's ability to effect explosive efforts. Inversely, this ability improves with the switch of metabolic processes to the synthesis of proteins.

2. A training session held the day after large-load practicals, even if loads are reduced in volume and intensity but are of the same specific directivity, leads to the intensified expenditure of protein, which was registered also in the course of other research projects [7, 31].

3. With the third training session running, even if volumetric (moderately intensive) loads are employed, there begin protein synthesis and plastic processes, the urea level goes down, and the NMA function begins to restore.

4. If rest is given after the first three days, the organism will fully restore its initial state. If a large-load day follows again, the afore-mentioned trend in the dynamics of functionality will repeat itself.

Proceeding from the specificities of protein metabolism and considering the materials mentioned above, an attempt was made to design "a developing" MC ensuring the ability to reach a marked increase in the level

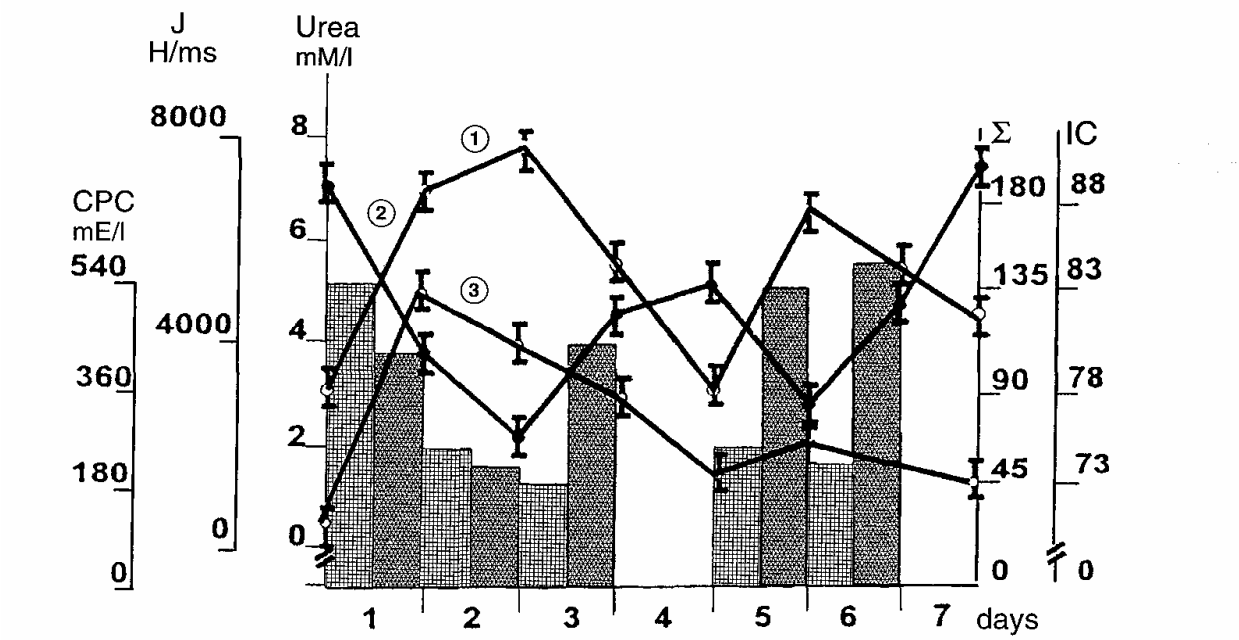

Figure 4. Dynamics of athletes' state in the microcycle (weight-lifting, n8). 1 - urea in the blood, 2 - indicator of the explosive strength of muscles (I), 3 - creatinphoshokinase (CPC). Training loads: the number of barbell lifts (E) (shade), intensity coefficient (IC) (double shade)

of an athlete's special physical training with the optimal expenditures of time and energy. Instead of "a gross" build-up in the volume of work and an increase in the number of training sessions with large loads of various directivity, a strong training impact on the organism was secured by "microblocks" (MB) of unidirectional load (Chart 5). MBs included a complex of several adjacent training days, of which the first two had catabolic directivity and the subsequent days revealed anabolic directivity. Anabolic directivity, depending on the strength of a training impact, in the first days measured 48-72 hours.

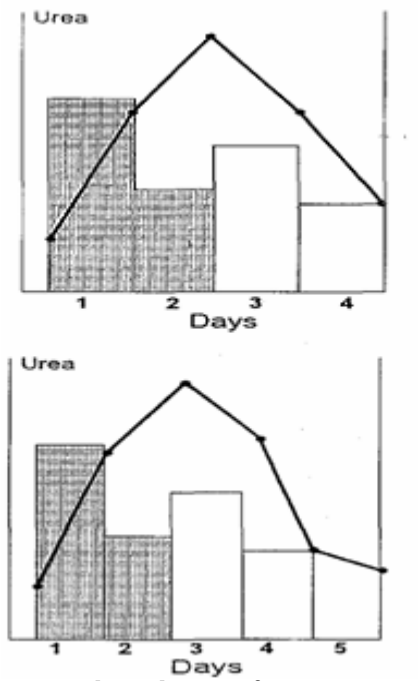

Figure 5. The scheme of organization of training impacts "microblocks". The chart illustrates the dynamics of urea concentration in the blood and the volumes of loads (columns); shaded columns are catabolic loads

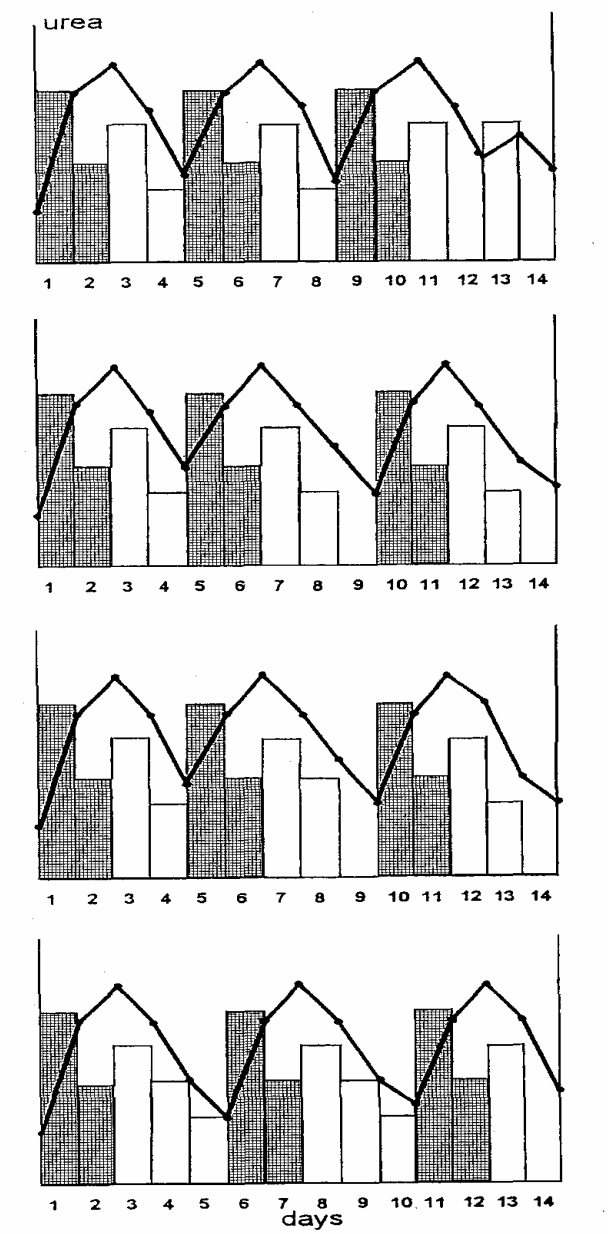

Figure 6. Variants of the organization of 14-day microcycles. Designations as on Figure 5

It proved to be that two such MBs do not fit into a week-long cycle. That is why two MC variants — two-weeks and one-week ones — were produced. The first variant covers three MBs (Chart 6) and, depending on the strength of training impacts in the

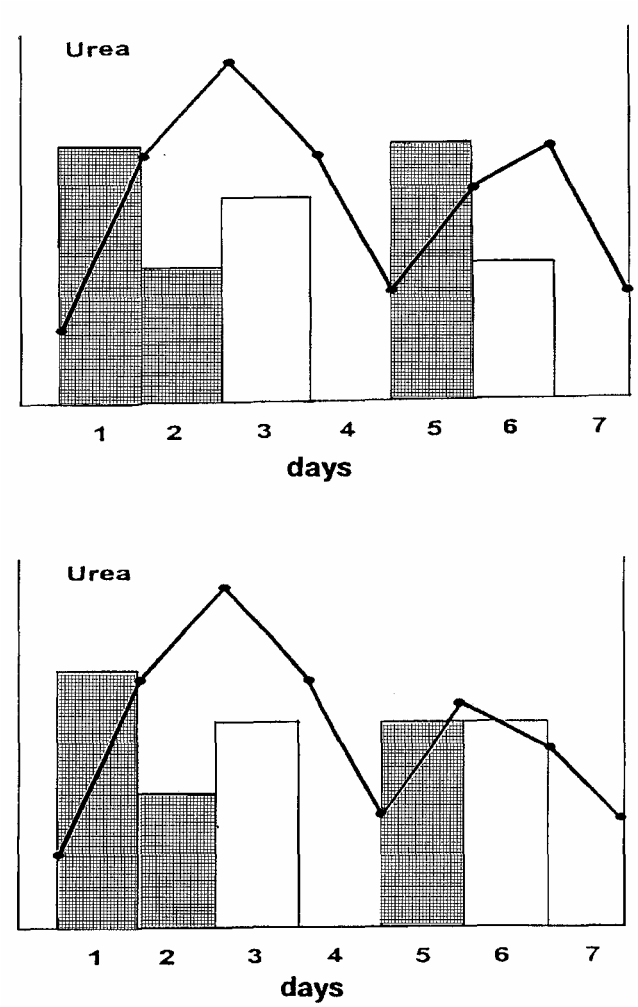

Figure 7. Variants of the organization of 7-day microcycles. Designations as on Figure 5.

catabolic phase, provides for protein synthesis in the course of 48 or 72 hours. The second variant (Chart 7) is intended for a special stage (designated as State B on Chart 2) which begins specialized work to raise the speed of a competitive exercise [56, 59, 60]. This MC makes it possible to fulfil the necessary volume of specific developing work while preserving the required level of the organism's functionality.

In this way, the MB concept allows us to create a large load on the organism with a relatively small volume of training effort. MBs make it possible to rationalize the system of loads in "developing" MCs for high-class athletes, raise the specific directivity of training impacts on the organism, and reduce (if not exclude) superfluous expenditures of energy not justified from the viewpoint of the logic of the adaptation process's development. The MB concept has been tested with regard to specialized power loads and it is extensively used, among others, by US hig-class culturists at the muscle build-up stage [58]. However, notwithstanding encouraging results, the idea of building MCs with the help of the MB of unidirectional loads needs further experimental backing.

It can be surmised that the solution of the MC issue can be facilitated by useful information on the periodicity of the synthesis of protein structures in the organism, particularly by the discovery that anabolic processes occur within 8-, 14-, 17-days endogenic cycles [201. If a training session with a large volume of work coincides with the phase of the enhanced preparedness of the cell's regulatory apparatus for the anabolic tuning of metabolism, a favourable effect will be achieved, and if it coincides with the phases of catabolic tuning, we can expect a worsening of the training effect [20, 44].

It is therefore looks expedient to plan the MC (both as far as the character and volume of loads are concerned) proceeding from the biological rhythm of trophic processes rather than the days of a week [20]. This idea was experimentally supported in the course of special power training (gymnastics). It was

established that the duration of changes in the organism's physiological functions does not fit in with the weekly cycle of training and averages 13.2 ±1.7 days [65]. Other studies, involving representatives of different sports, also showed that a training session would yield the most favourable effect if the natural biorhythm were in tune with metabolic changes in the body caused by physical loads.

A training day

This form of organization of training has long been used in sports practice. However, it has not yet received due experimental grounding and constructive methodological support. Repeated practicals during a day first attracted interest at the turn of the 1970s, when a trend emerged towards increasing the yearly volume of training load [6, 11, 28, 66, 69, 71], particularly by increasing the number of large-load training practicals within a weekly cycle. Experts' views on this score differ greatly and can be reduced to three variants as indicated below.

Under one variant, it is considered expedient to break down the general load of a training day into fragmented "portions". Experts holding this view believe that two-time training sessions during a day with the average load exceeding in size one large session are more effective than a one-time large load [49, 50, 67].

The second point of view is diametrically opposite to the first. Its advocates say that experienced coaches do not fragment one practical's work but introduce a second and third practicals [33, 38, 47, 48], which makes it possible to appreciably increase the aggregate volume of work done during a day without exposing an athlete to the danger of overfatigue.

The third point of view doubts the expediency of multiple daily training practicals mostly for endurance-oriented sports. According to the proponents of this view, experiments with daily repeated intensive training practicals reduce athletes' reserves of carbohydrates, which reveals itself in the reduction of glycogen content in the working muscle groups and in glucose content in the blood [5, 23]. Hence the conclusion: when it is required to build up the capacity and volume of the carbohydrates sources of the energy supply of muscle work, multiple practicals during a day will be inexpedient [19].

It is hardly expedient to set these opinions in opposition to one another. Each of them is probably fair for the specific conditions and tasks of training. It can be assumed that if, with unidirectional training, the agenda included a developing task to be handled by intensive techniques, it would be proper to have one large load for a day. If the developing task is solved by extensive techniques (to step up morphological changes in the organism), it would be good to have two unidirectional training sessions a day with the moderate intensity of muscular work.

Last but not least, in organizing training during a day it should be remembered that the human organism reveals different rhythms of functional activity depending upon the time of the day, which is due to the influence of external and intrinsic factors. Also, the daily (circuital) rhythms of the motor, vegetative and hormonal functions directly affect the level of an athlete's functionality [see surveys 40, 54-56].

Special studies have pointed to the expediency of organizing training during a day, with due account being taken of the daily rhythms of the organism life-sustaining functions [17,39,40,70,74,78]. Their results

should by all means be considered in organizing a training day.

To sum up, a training day is not just a package of training practicals. This is a part of the complex structure of training impacts on the organism, separated from the preceding and subsequent loads by the recuperative period of night sleep and interconnected with them via the content and directivity of plastic processes. The solution, via experiments, of issles connected with organizing a training day as part and parcel of the MC contains major reserves for rationalizing the system of training of extra-class athletes.

A training seance

A training seance (TS)[5] is a form of rationalizing one-time portion of training load, intended to achieve one specific target: to improve athletes' sportsmanship tactics and strategy or special physical training. TS includes a strictly dosed, monolithic structure of training impacts efficiently organized in time on the basis of the rational combination of work and recreation. TS can be a part of a training practical or a whole practical of a training day [55].

The practical need to isolate this form has been confirmed by special studies [27, 32, 43, 53, 54] which showed that, with the same composition and number of repetitions of exercises, the order of their performance and the regime of their alternation with rest act as a specific factor which determines both the quantitative and qualitative criteria of training impacts on the organism.

[5] From the French "seance", the interval of time covering the non-interrupted performance of a job of work or process.

TS is a complex of special exercises performed by the repetition-series method. As far as their organization is concerned, we can speak about the three following variants of the complexes of these exercises:

1. Complexes based on the favourable (invigorating) after-effect of a preliminary short-term power effort, making it possible subsequently to perform a targeted explosive or speed effort against the background of the enhanced excitability of the central nervous system [53]. This method is widely used in the training of throwers [8, 52], jumpers [18, 53, 55], short-distance runner [10], medium-distance [121 runners, swimmers [21, 53] and boxers [46].

2. Complexes which rely on the rational sequence and combination of means with different training directivity (in particular, towards the energy supply systems) and with the regulated regime of the alteration of work with rest as, for example, in boxing [3], athletic jumps [4, 34], soccer [35], and cyclic sports [14, 42, 681.

3. Complexes based on an athlete's rational motor activity in intervals between the repetitions of a training exercise which facilitates the enhanced oxidation of metabolites, the maintenance of the optimal level of excitability of the central nervous system, or the specification of the directive for action [12, 30, 34, 77].

Experiments have shown that rationally organized TSs appreciably raise the effectiveness of training impacts on the organism while reducing energy expenditure and promoting the more rational training process at the MC level. However, constructing TSs requires high professionalism based on the ability to impartially evaluate the training potential of the planned load, the knowledge of the

physiological mechanisms of the various means' and methods' time-limited training impact and the knowledge of the current recuperative processes. It is important to correctly determine the optimal dosage of means, objectively necessary duration of rest intervals between repeated work efforts and the way to fill these intervals, and know the character of changes in the load's training impact as an athlete grows fatigued.

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